

INNOLUX DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: _____

Model Name: AT035TN01 V.3

SPEC NO.: A035-01-TT-01



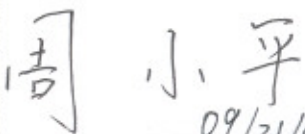
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- Preliminary Specification
 Final Specification

For Customer's Acceptance

Approved by	Comment

Approved by	Reviewed by	Prepared by
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1	2005/09/10		Initial release

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1. General Specifications

No.	Item	Specification	Remark
1	LCD size	3.5 inch	
2	Driver element	a-Si TFT active matrix	
3	Resolution	160X3(RGB)X234	
4	Display mode	Normally White, Transmissive	
5	Dot pitch	0.15(W)X0.216(H) mm	
6	Active area	72.0(W)X50.544(H) mm	
7	Module size	83.0(W)X60.5(H)X4.5(D) mm	Note 1
8	Surface treatment	Anti-Glare	
9	Color arrangement	RGB-delta	
10	Interface	Analog	
11	Backlight power consumption	0.3W (Typ.)	
12	Panel power consumption	35mW (Typ.)	
13	Weight	34.5 g \pm 10%	

Note 1: Refer to Mechanical Drawing.

2. Pin Assignment

2.1. TFT LCD Panel Driving Section

Pin No.	Symbol	I/O	Function	Remark
1	GND	-	Ground	
2	V _{CC}	P	Supply voltage for logic control circuit scan driver	
3	V _{GL}	P	Negative power for scan driver	
4	V _{GH}	P	Positive power for scan driver	
5	STVR	I/O	Vertical start pulse	Note 1
6	STVL	I/O	Vertical start pulse	Note 1
7	CKV	I	Shift clock input for scan driver	
8	U/D	I	UP/DOWN scan control input	Note 1, 2
9	OEV	I	Output enable control for scan driver	
10	V _{COM}	I	Common electrode driving signal	
11	V _{COM}	I	Common electrode driving signal	
12	GLED1	P	LED module 1 Cathode	
13	VLED1	P	LED module 1 Anode	
14	VLED2	P	LED module 2 Anode	
15	GLED2	P	LED module 2 Cathode	
16	L/R	I	LEFT/RIGHT scan control input	Note 1, 2
17	Q1H	I	Switch function to match different types of color filter	
18	OEH	I	Output enable control for data driver	
19	STHL	I/O	Start pulse for horizontal scan line	Note 1
20	STHR	I/O	Start pulse for horizontal scan line	Note 1
21	CPH3	I	Sampling and shifting clock pulse for data driver	
22	CPH2	I	Sampling and shifting clock pulse for data driver	

23	CPH1	I	Sampling and shifting clock pulse for data driver	
24	V _{CC}	P	Supply voltage for logic control circuit scan driver	
25	GND	-	Ground	
26	V _R	I	Alternated video signal (Red)	
27	V _G	I	Alternated video signal (Green)	
28	V _B	I	Alternated video signal (Blue)	
29	AV _{DD}	P	Supply voltage for analog circuit	
30	AV _{SS}	-	Ground for analog circuit	

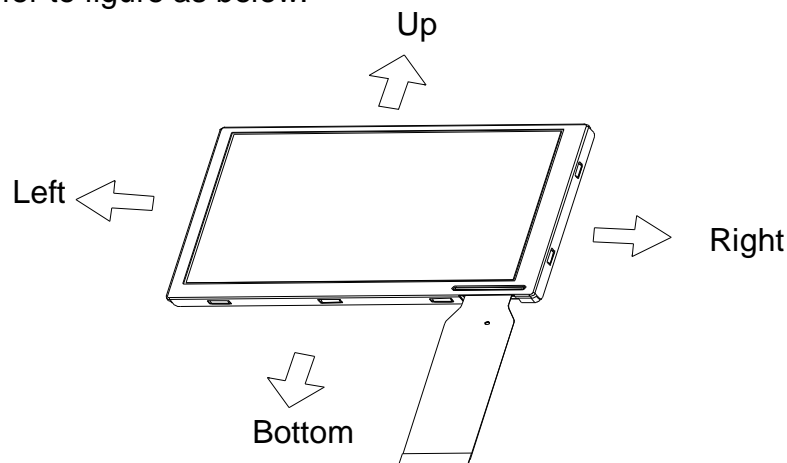
I: input, O: output, P: power

Note 1: Selection of scanning mode

Setting of scan control input		IN/OUT state for start pulse				Scanning direction
U/D	L/R	STVR	STVL	STHR	STHL	
GND	V _{CC}	O	I	O	I	Up to down, left to right
V _{CC}	GND	I	O	I	O	Down to up, right to left
GND	GND	O	I	I	O	Up to down, right to left
V _{CC}	V _{CC}	I	O	O	I	Down to up, left to right

Note 2: Definition of scanning direction.

Refer to figure as below:



Note 3: MOD=H: Simultaneous sampling.

MOD=L: Sequential sampling.

Please set CPH2 and CPH3 to GND when MOD=H.

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3. Operation Specifications

3.1. Absolute Maximum Rating

(GND=AV_{SS}=0V, Note 3)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	V _{CC}	-0.3	7	V	
	AV _{DD}	-0.3	7	V	
	V _{GH}	-0.3	18	V	
	V _{GL}	-15	0.3	V	
	V _{GH} -V _{GL}	-	33	V	
Input signal voltage	V _i	-0.2	AV _{DD} +0.2	V	Note 1
	V _l	-0.3	V _{CC} +0.3	V	Note 2
Operation Temperature	T _{OP}	-20	70	°C	
Storage Temperature	T _{ST}	-30	80	°C	

Note 1: V_R, V_G, V_B.

Note 2: STHL, STHR, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.

Note 3: The absolute maximum rating values of the module should not be exceeded. Once exceeded absolute maximum rating values, the characteristics of the module may not be recovered. Even in an extreme condition, may result in module permanently destroyed.

3.2. Electrical Characteristics

3.2.1. Typical Operation Conditions

(GND=AV_{SS}=0V, Note 4)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	V _{CC}	3	5	5.2	V	
	AV _{DD}	4.8	5	5.2	V	
	V _{GH}	14.3	15	15.7	V	
	V _{GL}	-10.5	-10	-9.5	V	
Video signal amplitude (V _R , V _G , V _B)	V _{iA}	0.4	-	AV _{DD} -0.4	V	Note 1
	V _{iAC}	-	3	-	V	AC component
	V _{iDC}	-	AV _{DD} /2	-	V	DC component
V _{COM}	V _{CAC}	3.5	5	6.5	V	Note 2
	V _{CDC}	1.0	1.25	1.5	V	DC component
Input logic high voltage	V _{IH}	0.8V _{CC}	-	V _{CC}	V	Note 3
Input logic low voltage	V _{IL}	0	-	0.2V _{CC}	V	

Note 1: Refer to Fig.3-3-(a).

Note 2: The brightness of LCD panel could be changed by adjusting the AC component of V_{COM}.

Note 3: STHL, STHR, OEHL, L/R, CPH1~CPH3, STVR, STVL, OEVL, CKV, U/D.

Note 4: GND, V_{CC}, and V_{GL} are applied to LCD first and then V_{GH} is applied.

3.2.2. Current Consumption

(GND=AV_{SS}=0V)

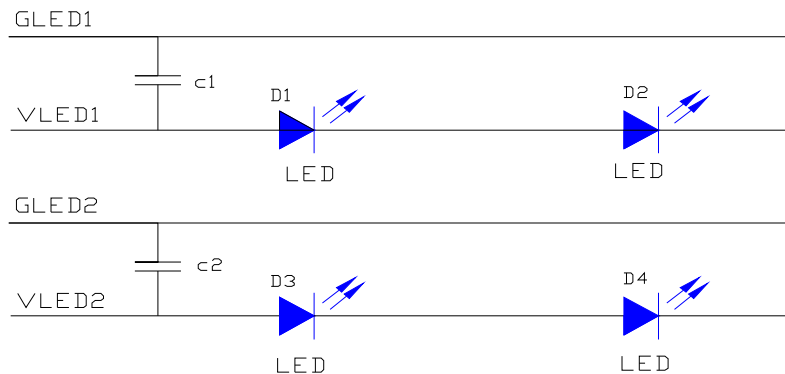
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I _{GH}	-	100	300	uA	V _{GH} =15V
	I _{GL}	-	-100	-300	uA	V _{GL} = -10V
	I _{CC}	-	1.5	4	mA	V _{CC} =5V
	I _{DD}	-	5	10	mA	AV _{DD} =5V

3.2.3. Backlight Driving Condition

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LED voltage	V _L	-	7.5	-	V	Note 2
LED current	I _L	-	20	-	mA	Note 2
LED life time	-	20,000	-	-	Hr	Note 1

Note 1: The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and I_L =20mA.

Note 2: The Backlight driving condition is defined for each LED module (2 LED Serial).



3.3. Timing Characteristics

3.3.1. Timing Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Rising time	t_r	-	-	10	ns	Note 1
Falling time	t_f	-	-	10	ns	Note 1
High and low level pulse width	t_{CPH}	299	312	342	ns	CPH1~CPH3
CPH pulse duty	t_{CWH}	40	50	60	%	CPH1~CPH3
CPH pulse delay	t_{C12}	70	$t_{CPH}/3$	$t_{CPH}/2$	ns	CPH1~CPH3
	t_{C23}					
	t_{C31}					
STH setup time	t_{SUH}	35	-	-	ns	STHR, STHL
STH hold time	t_{HDH}	35	-	-	ns	STHR, STHL
STH pulse width	t_{STH}	-	1	-	t_{CPH}	STHR, STHL
STH period	t_H	61.5	63.5	65.5	μs	STHR, STHL
OEH pulse width	t_{OEH}	-	3	-	μs	
Sample and hold disable time	t_{DIS1}	-	8.42	-	μs	
OEV pulse width	t_{OEV}	-	13	-	μs	
CKV pulse width	t_{CKV}	16	20	40	μs	
Clean enable time	t_{DIS2}	-	10	-	μs	
Horizontal display start	t_{SH}	-	0	-	$t_{CPH}/3$	
Horizontal display timing range	t_{DH}	-	480	-	$t_{CPH}/3$	
STV setup time	t_{SUV}	400	-	-	ns	STVL, STVR
STV hold time	t_{HDV}	400	-	-	ns	STVL, STVR
STV pulse width	t_{STV}	-	-	1	t_H	STVL, STVR
Horizontal lines per field	t_V	256	262	268	t_H	Note 2

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Vertical display start	t_{SV}	-	3	-	t_H	
Vertical display timing range	t_{DV}	-	234	-	t_H	
V_{COM} rising time	t_{rCOM}	-	-	5	μs	
V_{COM} falling time	t_{fCOM}	-	-	5	μs	
V_{COM} delay time	t_{DCOM}	-	-	3	μs	
RGB delay time	t_{DRGB}	-	-	1	μs	

Note 1: For all of the logic signals

Note 2: Please don't use odd horizontal lines to drive LCD panel for both odd and even field simultaneously.

3.3.2. Timing Diagram

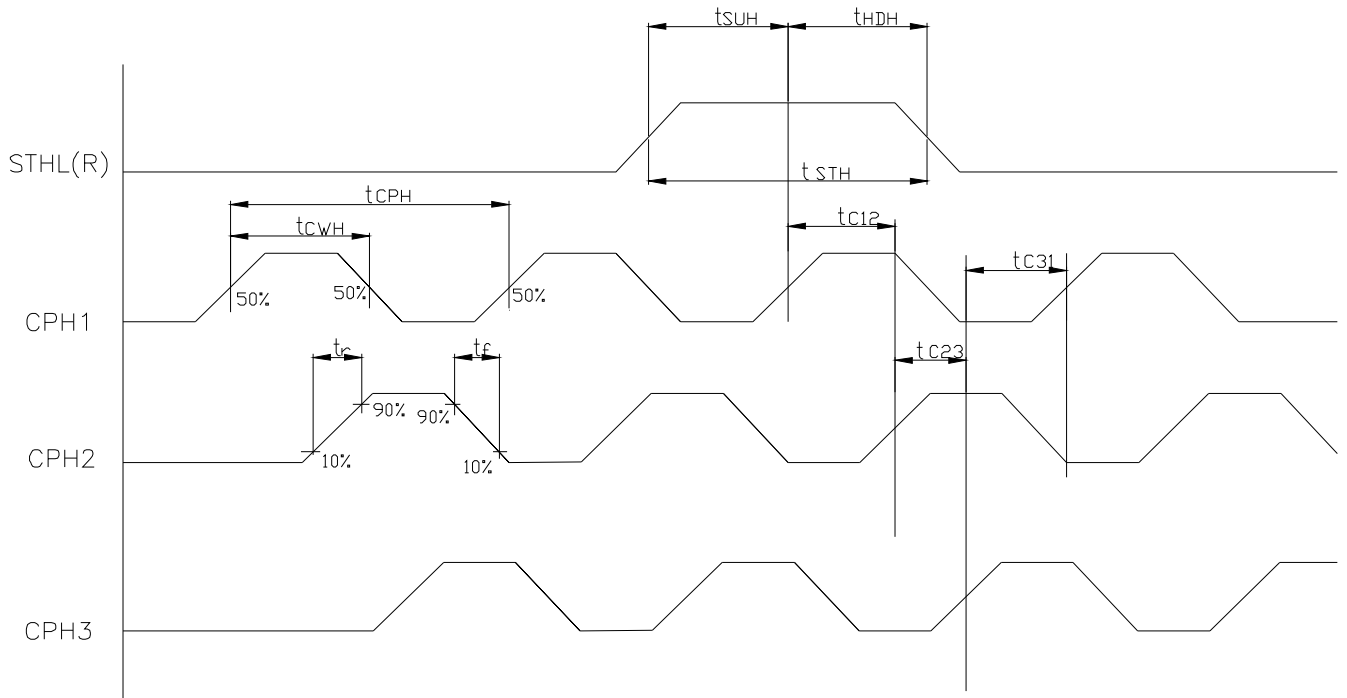


Fig.3-1 Sampling clock timing

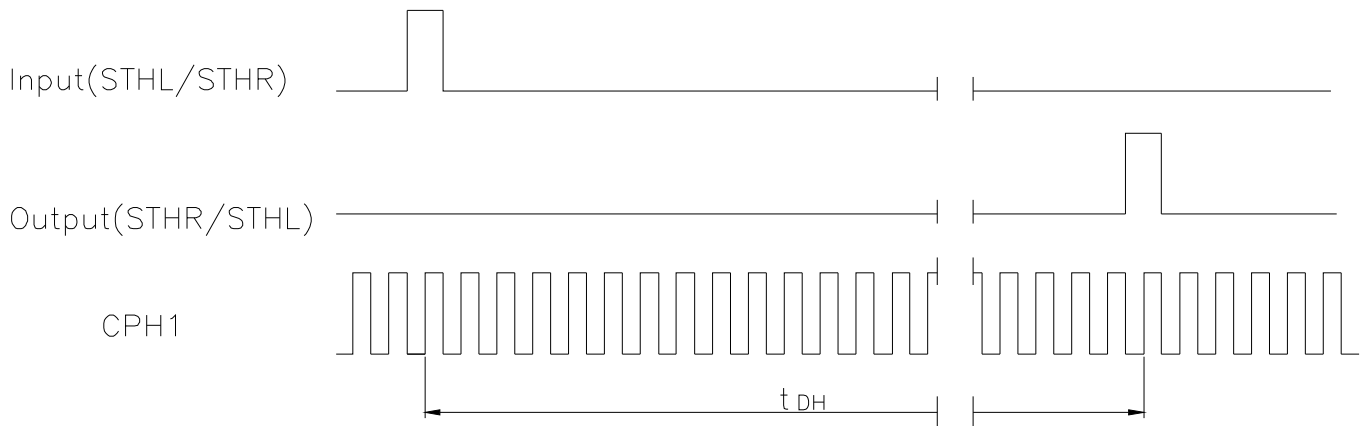


Fig.3-2 Horizontal display timing range

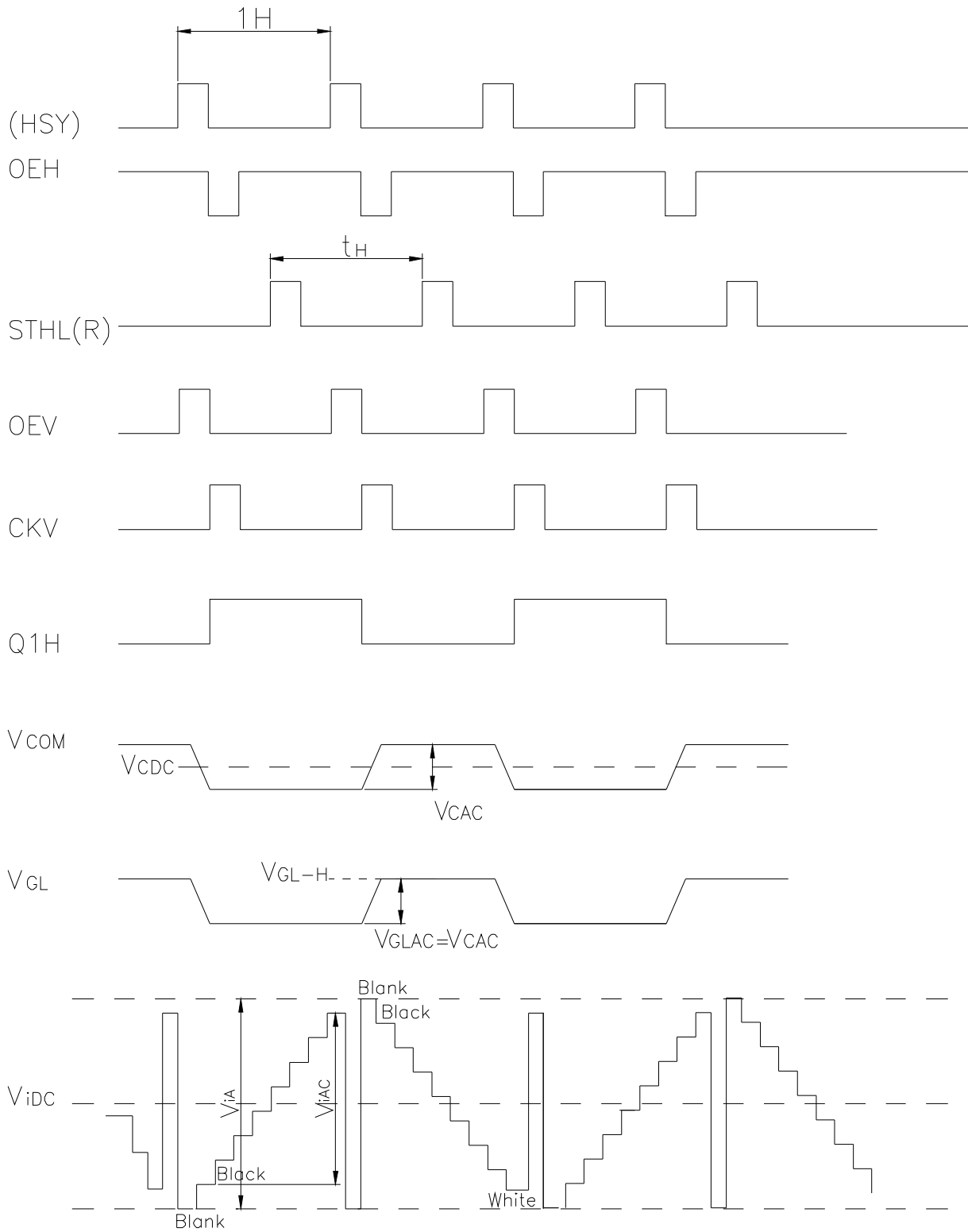
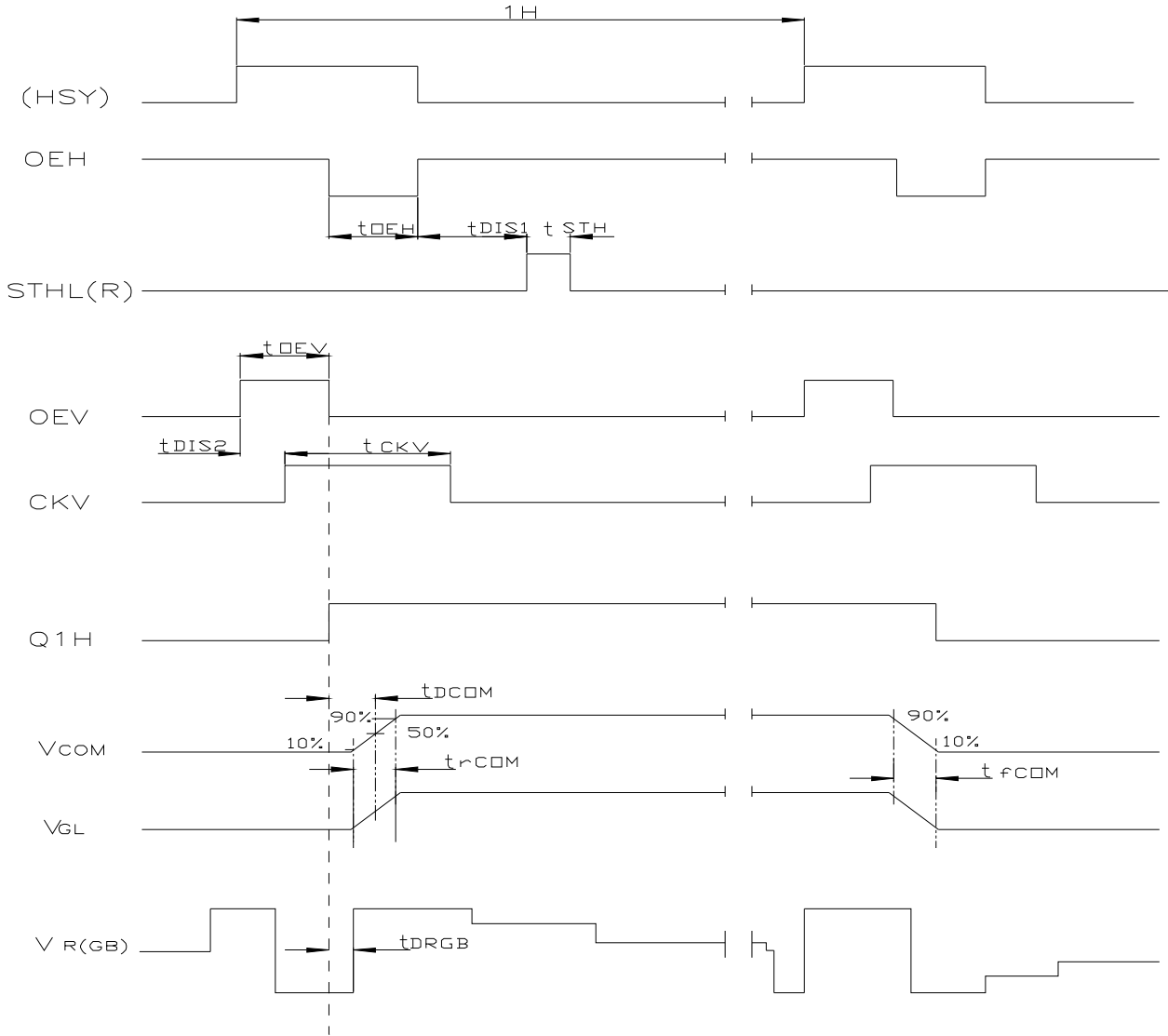


Fig.3-3-(a) Horizontal timing



Note: The falling edge of OEV should be synchronized with the falling edge of OEH
 Fig.3-3-(b) Detail horizontal timing

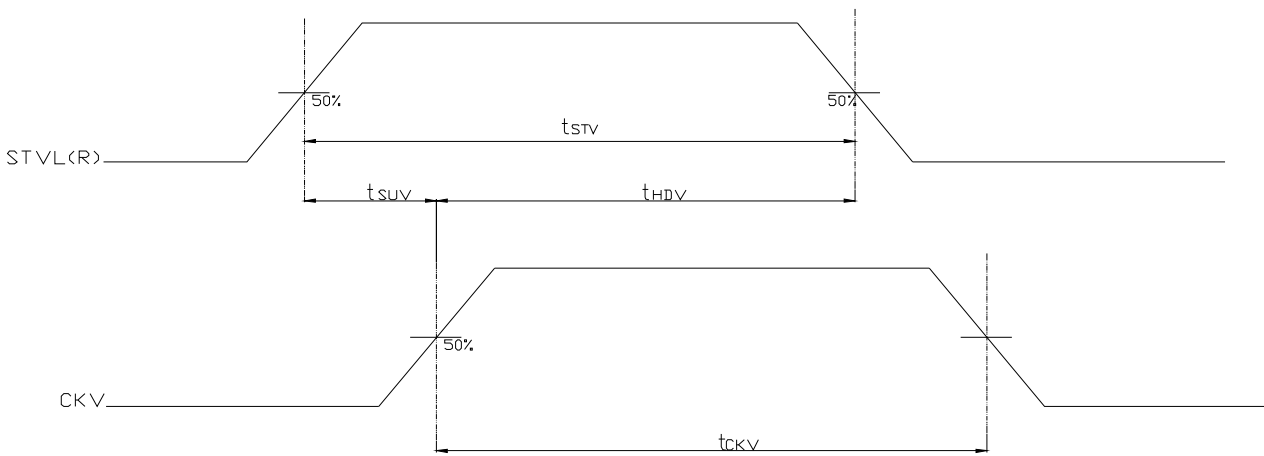


Fig.3-4 Vertical shift clock timing

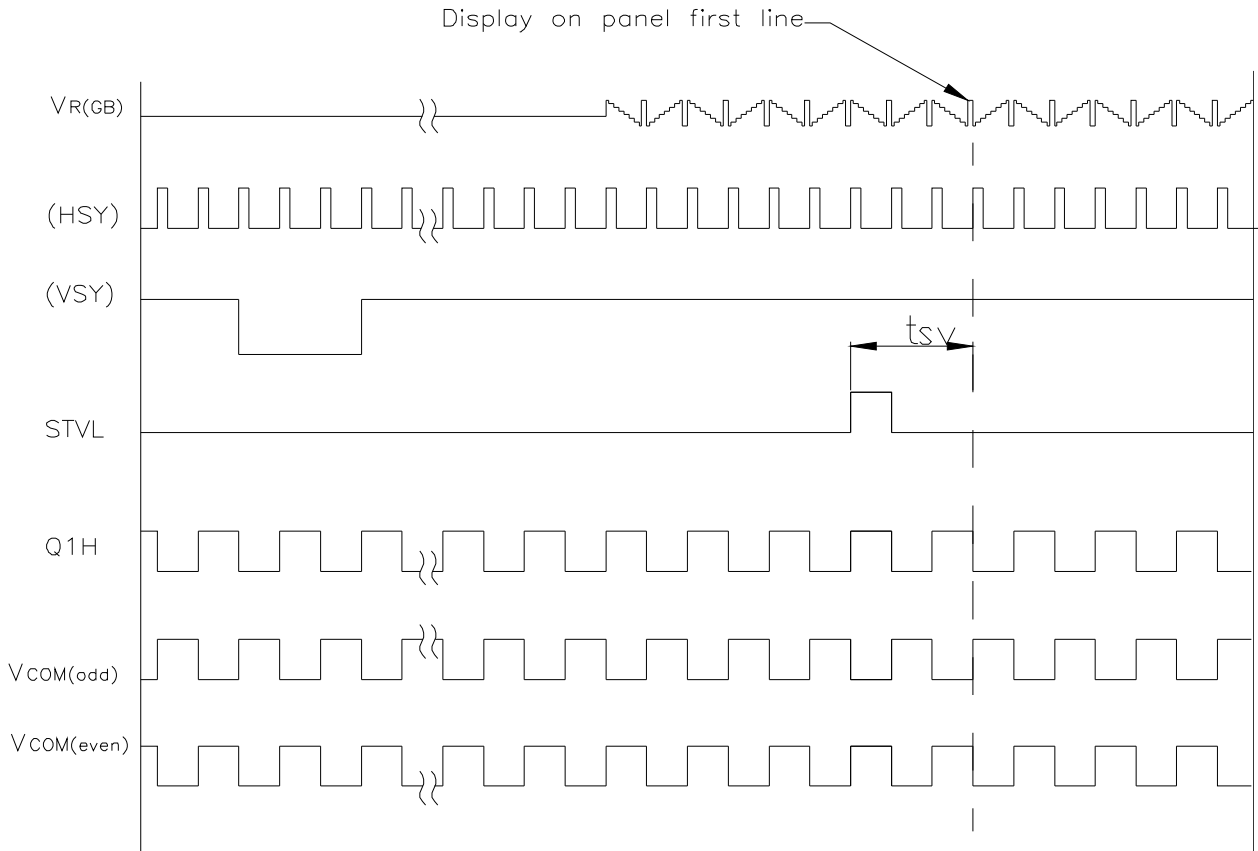


Fig.3-5(a) Vertical timing (from up to down)

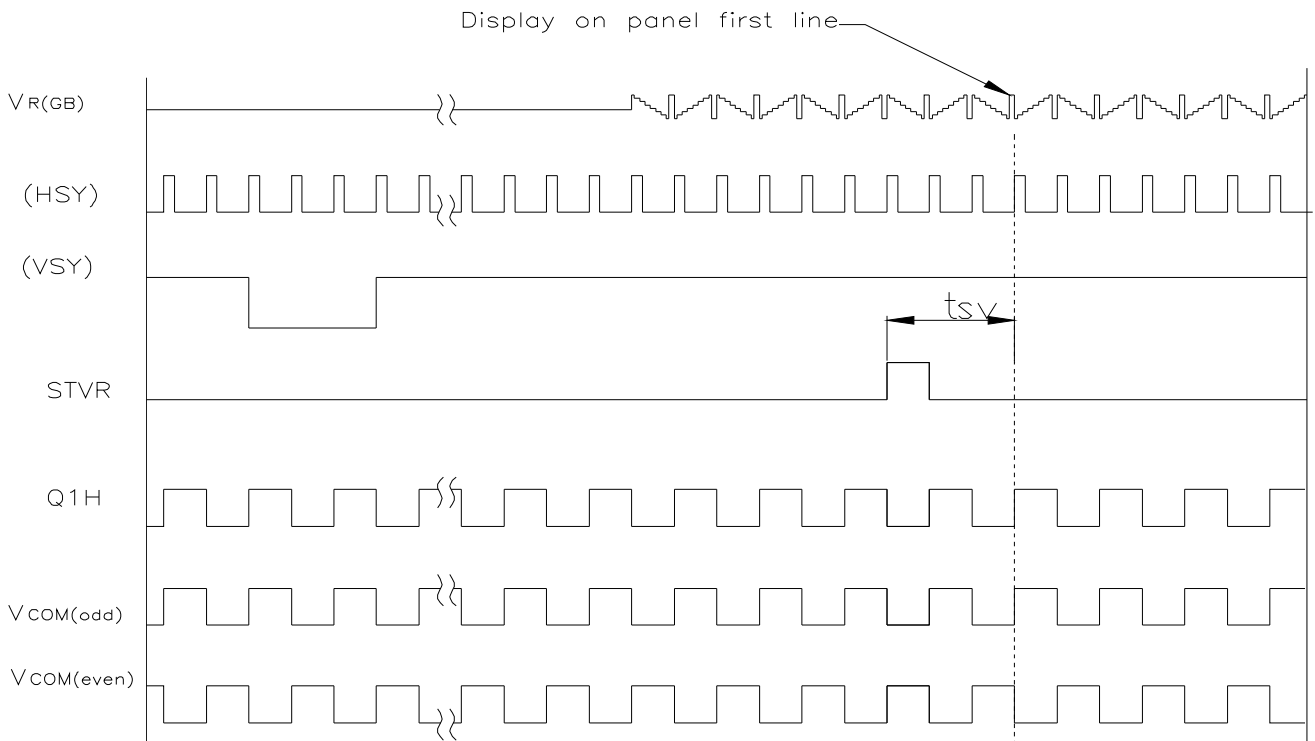


Fig.3-5(b) Vertical timing (from down to up)

4. Optical Specifications

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle (CR≥10)	θ_L	$\Phi=180^\circ$ (9 o'clock)	40	45	-	degree	Note 1
	θ_R	$\Phi=0^\circ$ (3 o'clock)	40	45	-		
	θ_T	$\Phi=90^\circ$ (12 o'clock)	10	15	-		
	θ_B	$\Phi=270^\circ$ (6 o'clock)	30	35	-		
Response Time	T_{ON}	Normal $\theta=\Phi=0^\circ$	-	20	30	msec	Note 3
	T_{OFF}		-	30	40	msec	Note 3
Contrast ratio	CR		150	200	-	-	Note 4
Color chromaticity	W_X		0.26	0.31	0.36	-	Note 5 Note 6
	W_Y		0.28	0.33	0.38	-	
Luminance	L		150	200	-	cd/m ²	Note 6
Luminance uniformity	Y_U		70	75	-	-	Note 7

Test Conditions:

1. $V_{CC}=5V$, $AV_{DD}=5V$, $I_L=20mA$ (Backlight current), the ambient temperature is $25^\circ C$.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

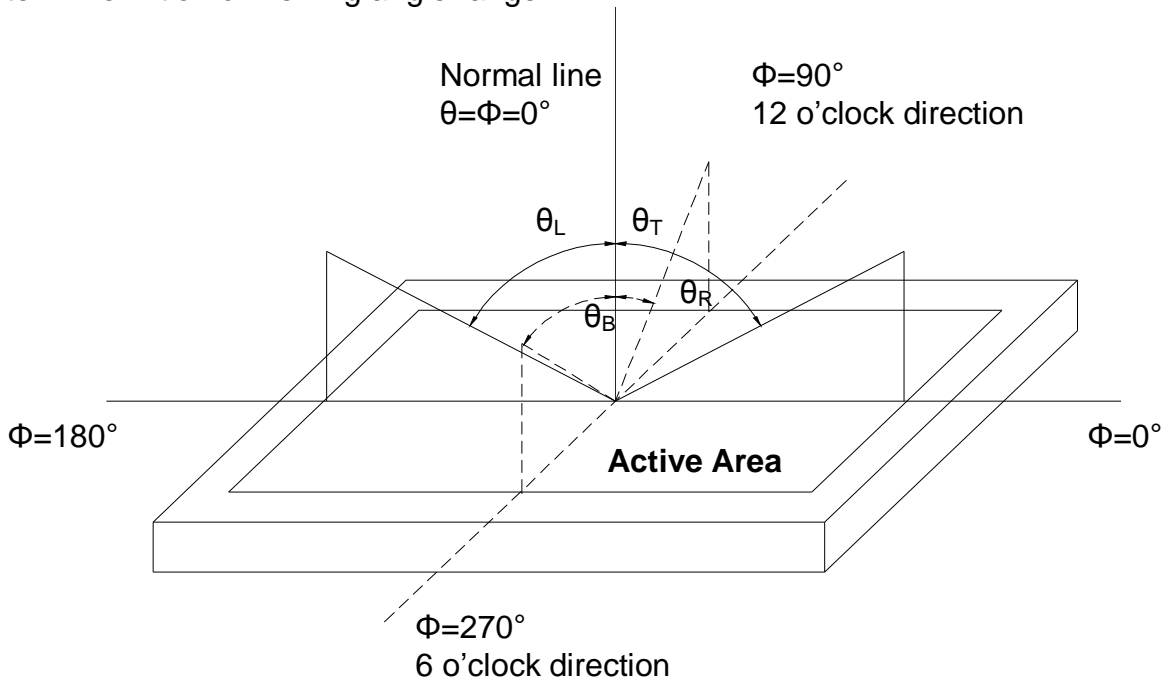


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. The optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/Field of view: 1° /Height: 500mm.)

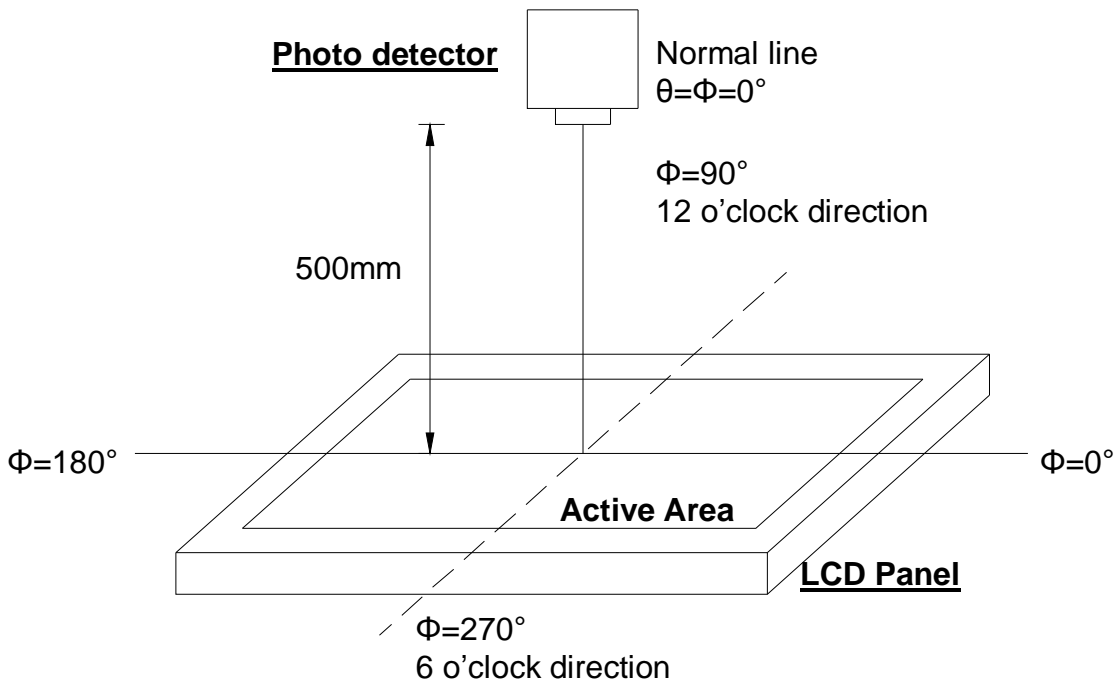


Fig. 4-2 Optical measurement system setup

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Note 3: Definition of Response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.

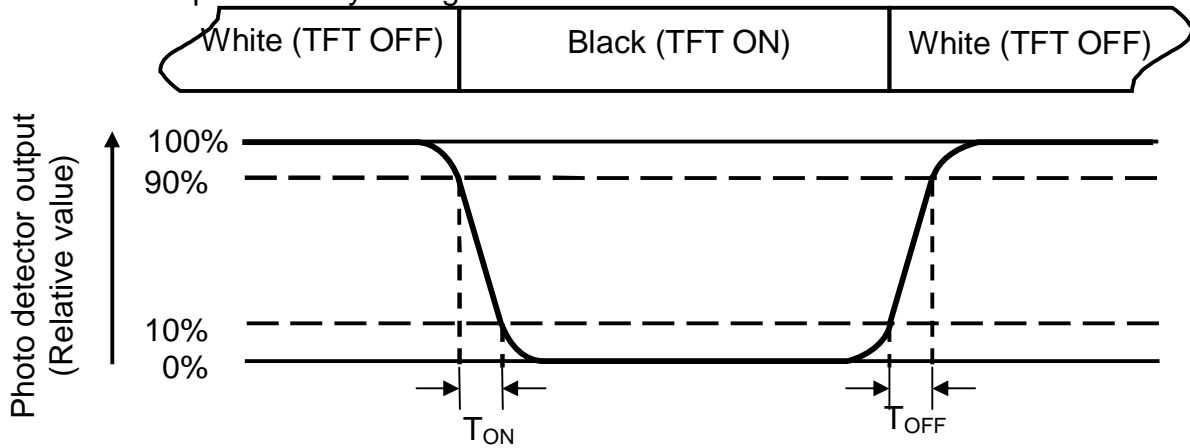


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

White $V_i = V_{i50\%} \pm 1.5 \text{ V}$

Black $V_i = V_{i50\%} \mp 2.0 \text{ V}$

"±" means that the analog input signal swings in phase with V_{COM} signal.

"∓" means that the analog input signal swings out of phase with V_{COM} signal.

$V_{i50\%}$: The analog input voltage when transmission is 50%

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: All input terminals LCD panel must be ground when measuring the center area of the panel.

Note 7: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer to Fig. 4-4).Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (Yu)} = \frac{B_{min}}{B_{max}}$$

L-----Active area length W----- Active area width

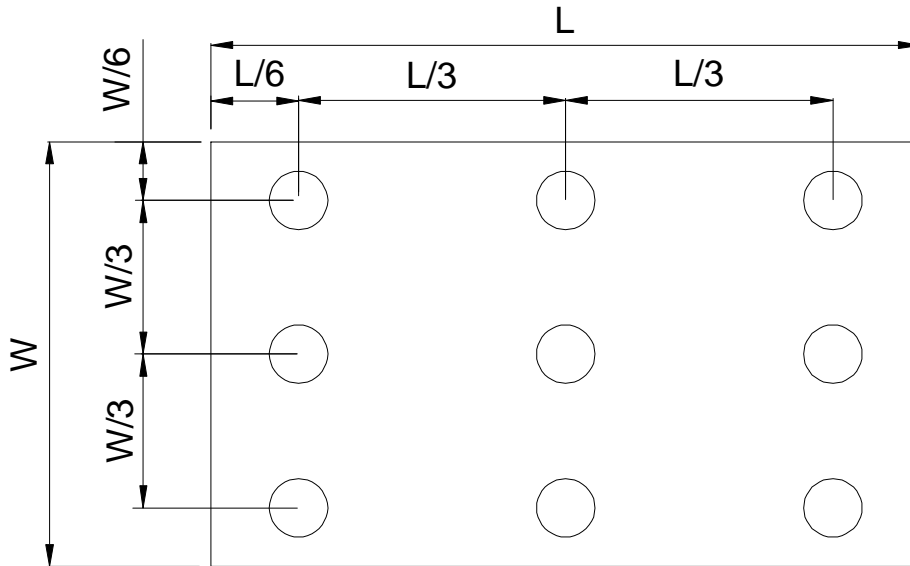


Fig. 4-4 Definition of measuring points

B_{max}: The measured maximum luminance of all measurement position.

B_{min}: The measured minimum luminance of all measurement position.

6. Handling Precautions

6.1. Safety

Liquid crystal is poisonous. Do not put it in your mouth. If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

6.2. Handling

1. The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
2. The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.
3. To avoid contamination on the display surface, do not touch the module surface with bare hands.
4. Keep a space so that the LCD panels do not touch other components.
5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.
6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.
7. Do not leave module in direct sunlight to avoid malfunction of the ICs.

6.3. Static Electricity

1. Be sure to ground module before turning on power or operating module.
2. Do not apply voltage which exceeds the absolute maximum rating value.

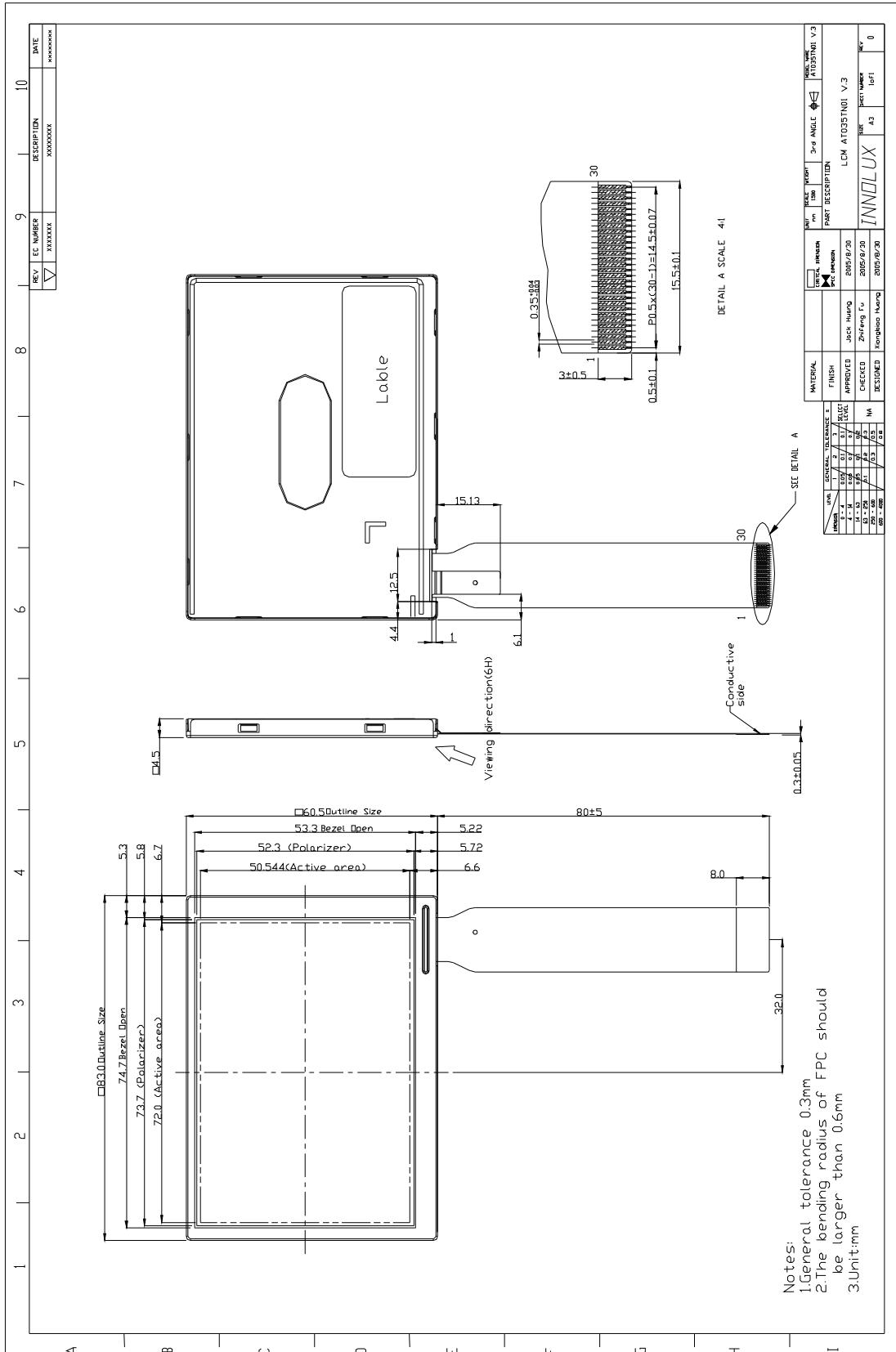
6.4. Storage

1. Store the module in a dark room where must keep at $+25\pm 10^{\circ}\text{C}$ and 65%RH or less.
2. Do not store the module in surroundings containing organic solvent or corrosive gas.
3. Store the module in an anti-electrostatic container or bag.

6.5. Cleaning

1. Do not wipe the polarizer with dry cloth. It might cause scratch.
2. Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.

7. Mechanical Drawing



8. Package Drawing

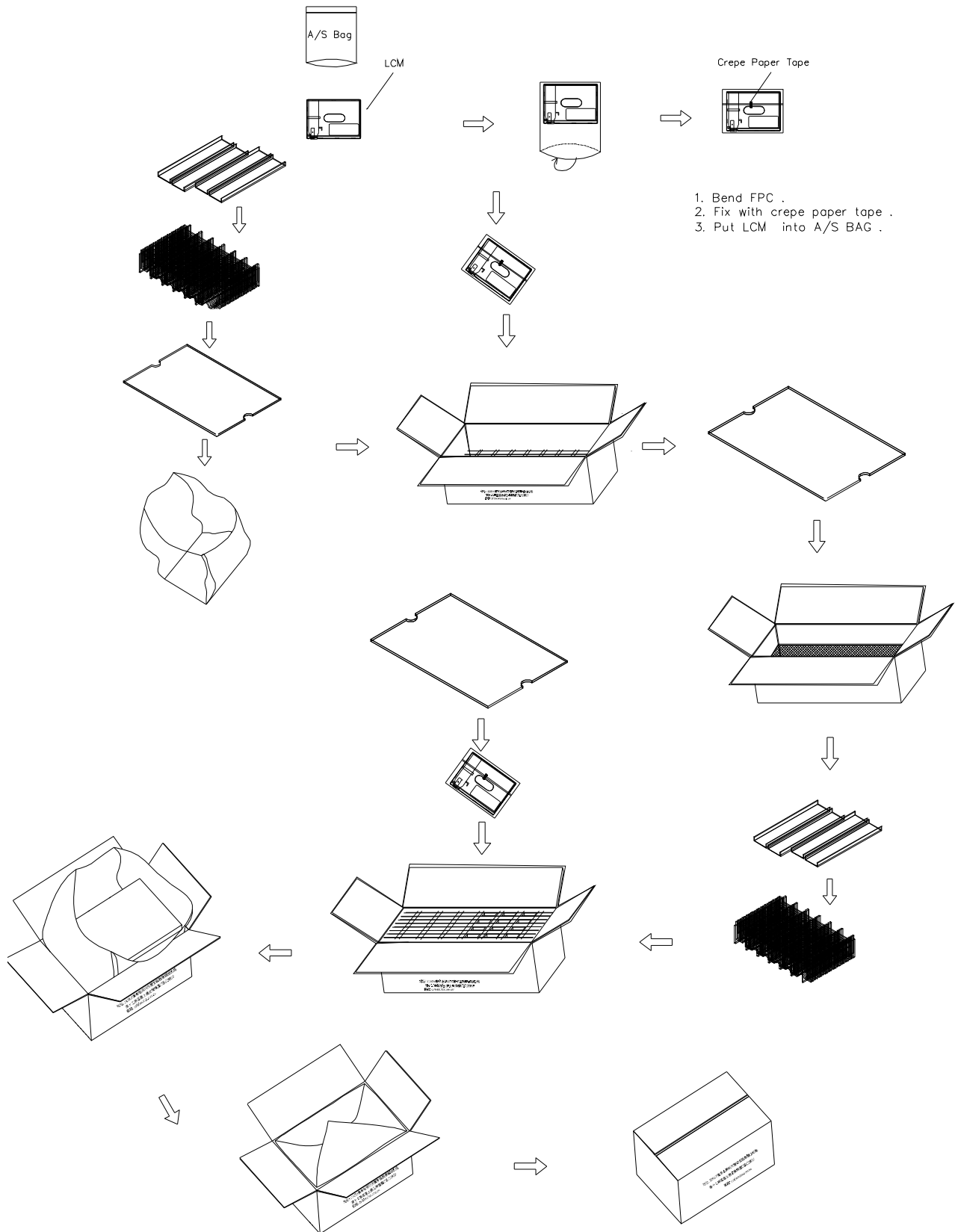
8.1. Packaging Material Table

No.	Item	Model (Material)	Dimensions (mm)	Unit Weight (kg)	Quantity	Remark
1	LCM module	AT035TN01 V.3	83.0×60.5×4.5	0.0345	252pcs	
2	Corrugated Board	B Corrugated paper	510x350	0.144	3pcs	
3	Corrugated Bar	B Corrugated paper	349x100	0.020	12pcs	
4	Partition	BC Corrugated paper	512x349x106	0.884	2pcs	
5	Dust-Proof Bag	PE	700x530	0.048	1pcs	
6	A/S Bag	PE	112x90	0.857×10^{-3}	252pcs	
7	Carton	Corrugated paper	530x355x255	1.1	1pcs	
8	Total weight	12.5Kg ± 5%				

8.2. Packaging Quantity

(1) LCM quantity per Partition:	6 row x 21pcs = 126pcs
(2) Total LCM quantity in Carton:	2 layer x 126pcs per Partition = 252pcs

8.3. Packaging Drawing



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